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PREFACE

Special Issue of Journal of Multiple-Valued Logic and Soft Computing on Theory and Applications with Recent Fuzzy Sets Extensions

Thanks to the extensions of Zadeh (1965) ordinary fuzzy sets, fuzzy set theory has found the opportunity to expand. Atanassov's (1986) intuitionistic fuzzy sets showed the direction of the theory to other researchers and almost all researchers followed this path and reached new sub-extensions. The main idea is that the membership degree should be defined with more than one parameter based on the fact that the decision maker can be indecisive. Thus, new concepts such as indecisiveness degree and refusal degree have been introduced. While intuitionistic fuzzy sets are defined with two parameters, Picture fuzzy sets defined with three parameters belong to a separate category from intuitionistic fuzzy sets in this respect and have been the basis for extensions such as spherical fuzzy sets. The problem of how to assign membership degrees in fuzzy sets has been given less attention. When looking at fuzzy set applications in the literature, it is seen that experts assign one-digit or at most two-digit membership degrees. Asking experts to assign proportional values between parameters can provide more precise and robust assignments. Kahraman's (2024) proportional fuzzy sets were developed with this in mind and have become a feasible approach in all fuzzy set extensions.

This issue includes eleven original papers on the theory and applications of the fuzzy set extensions in various research areas, each written by their well-known experts. The first paper presents a novel approach for constructing stable type-3 fuzzy controllers with the fuzzy Lyapunov method. The authors propose the extension of the approach to type-3 fuzzy control. The main idea is that with the fuzzy Lyapunov approach they are able to build stable type-3 fuzzy controllers for diverse applications. The second paper addresses the selection of a post-disaster telecommunication service provider and proposes a new Proportional Intuitionistic Fuzzy AHP&VIKOR method-

ology for this purpose. This approach provides decision makers with the opportunity to represent values in a more accurate and understandable way. The third paper introduces intuitionistic fuzzy modal operators. An addition to the intuitionistic fuzzy analogues of the classical modal operators "necessity" and "possibility", the authors consider the most general of these operators. It is shown that with appropriate choice of its parameters, this operator can transform the intuitionistic fuzzy values of an arbitrary IFS to the intuitionistic fuzzy values of another arbitrarily chosen IFS

The fourth paper evaluates energy management system (EMS) strategies for electric vehicles using the proportional Pythagorean fuzzy analytic hierarchy process to prioritize decision criteria. To achieve this, a decision model is constructed involving four main criteria and sixteen sub-criteria. Then, pairwise evaluations from five experts are collected and aggregated leading to the prioritization of decision criteria. The fifth paper describes rough sets and rule induction in possibilistic in formation data tables with values expressed in normal possibility distributions. A possibilistic information data table is transformed into the set of incomplete information data tables with possible degrees by using -cut. Every incomplete information data table is dealt with from the viewpoint of possible world semantics used by Lipski and creates possible tables. The sixth paper develops a multi-expert proportional spherical fuzzy integrated AHP&TOPSIS methodology in which AHP is used for computing the criteria weights and TOPSIS is used for selecting the best robotic process automation alternative. Comparative and sensitivity analyses are also applied to determine the validation and robustness of robotic process automation selection decision.

The seventh paper develops intelligent computing systems for decision support in various fields of application with a large volume of fuzzy input information. The proposed approach is based on a combination of the advantages of optical color logic architecture, with high performance performing the main logical operations of disjunction, conjunction and negation, and fuzzy digital computing, significantly expanding the functionality of soft computing for the formation of various trajectories of decision output. The eight paper introduces a novel framework by integrating fuzzy competition graphs and cubic fuzzy sets to enhance precision in handling ambiguity and uncertainty in analyzing competitive interactions with cubic fuzzy information. Initially, the cubic fuzzy competition graph and its extension, the cubic fuzzy p-competition graph, are defined. Several pertinent properties are outlined alongside these concepts. The ninth paper proposes a fuzzy-based user equity scheduler to prioritize traffic according to a plan through a dynamic fuzzy inference system. The fuzzy logic engine uses fuzzy rule reasoning to define packet priorities. The priority is proportional to traffic types that are more likely to miss their quality of service requirements and have poor channel conditions. Simulations are used to compare and analyze the proposed

scheduler fuzzy-based user equity scheduler with six other scheduling methods based on fairness and performance metrics.

The tenth paper introduces a novel price forecasting approach by integrating modified ordinary differential equations with intuitionistic fuzzy sets. The ordinary differential equations method employs periodic and polynomial function forms, with coefficients determined using the weighted least squares method. By exploring various parameter configurations over selected time horizons, the model adapts to diverse data dynamics. The last paper focuses on developing a new extension of analytic hierarchy process by using intuitionistic fuzzy sets with ordered pairs. By leveraging the functionality of two-way questions, positive and negative, the membership degrees are determined, and fuzzy sets are constructed based on expert responses. The research contributes to the field by introducing a hierarchical prioritization using the recently introduced intuitionistic fuzzy sets with ordered pairs.

I thank the anonymous reviewers for their hard works in selecting high-quality papers of this issue. This issue would be impossible without their invaluable efforts. I would like to thank the world-renowned researchers who chose the MVLSC journal to publish their valuable works in this issue. I would also like to express my sincere thanks to Editor-in-Chief of the journal, Prof. Dan Simovici for his continuous supports and helps.

Prof. Cengiz Kahraman

REFERENCES

[1] Atanassov, K., Intuitionistic fuzzy sets, Fuzzy Sets System, 20 (1) (1986) 87–96.
[2] Kahraman, C., Proportional Picture Fuzzy Sets and Their AHP Extension: Application to Waste Disposal Site Selection, Expert Systems With Applications, Volume 238, Part F, 15 March 2024, 122354.
[3] Zadeh, L.A., Fuzzy set, Information and Control, 8 (3) (1965) 338-353.